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RESEARCH IN THE SOVIET ARCTIC

N. N. Zubov

The following are extracts of pertinent information selected from N. N. Zubov's "In the Center of the Arctic."

Zubov made a reconnaisance flight over the Kara Sea in late May 1939 to check the state of the ice before the beginning of Arctic navigation. This flight laid the groundwork for the now compulsory prenavigation ice surveys of all Arctic seas. In late August 1946, Zubov flew across all seas of the North Arctic from the Kara Sea around Cape Chelyuskin to the Chukchee Sea and back.

A Soviet air expedition led by O. Yu. Shmidt with four heavy planes and one light plane left Moscow, 22 March 1937, and landed on Rudolph Island, 18 April. The ice on Rudolph Island is a natural landing field for planes.

M. V. Vodop'yanov reached the North Pole on 21 May 1937 and landed at 89 26 latitude and 282 longitude. Polar Station No 56 began operations.

Later, planes flown by V. S. Molokov, A. D. Alekseyev, and I. P. Mazuruk landed. All planes returned 6 June, leaving I. D. Papanin, director; P. P. Shirshov, hydrobiologist; Ye. K. Fedorov, astronomer; and E. T. Krenkel', radioman. Polar Station No 56's drift lasted 274 days and covered 2100 kilometers. Thirty-three measurements of ocean depth were made, 14 over 3 kilometers. Twenty-two hydrological observations were made to collect organisms at various ocean depths, and the same number of gravimetric observations were made. Magnetic and atmospheric-electric observations were also made.

Processing and publication of collected data is still not finished. The expedition definitely established that there are not, and cannot be, any islands or lands in the North Pole region. The relief of the bottom was studied over the entire path of the drift. It was established that warm Atlantic waters pass by deep currents from the Greenland Sea up to the Pole itself, and that the water temperature is increased in the deep depression of the Arctic Basin due to the internal heat of the earth.

Movement of the upper layers of water (about 200 meters thick) under action of wind was studied for the first time. Meteorological observations disproved previous concepts of the structure and circulation of the atmosphere in the polar regions and gravimetric and magnetic observations yielded valuable results. However, observations of the "North Pole" station on the drift and behavior of the ice fields of the Central Arctic were most important.

While searching for Levanevskiy's four-motored plane, lost 13 August 1937, en route to North America over the North Pole, M. V. Vodop'yanov made the first flight in aviation history under conditions of advancing polar night.

The drift of the "Sedov" is important in that it began before the drift of the "North Pole" station ended, thus providing continuous observations on ice movements in the Central Arctic for almost 3 years. During the drift, 1 September 1938 to 13 January 1940, 415 astronomical determinations of the ship position were made. The depth of the ocean was measured; bottom specimens were collected at 37 points. Of the 43 hydrological observations, some included direct measurement of sea currents. Eleven collections of plankton were made. Elements of terrestrial magnetism were measured at 78 points, and gravimetric measurements were made at 66 points. Meteorological observations were made every 2 hours. Value of the observations is somewhat impaired because there were no scientists aboard other than V. Kh. Buynitskiy, then a student of the Hydrographic Institute, Main Administration of the Northern Sea Route.

Three landings made by a plane, piloted by Cherevichnyy, north of Vrangel' Island from 3 April to 29 April 1941 proved that heavy planes can land on ice of the Arctic Basin wherever pack ice is observed. Measurements showed that the depth of 5,540 meters, measured by Wilkins, at 77 46 latitude and 185 longitude is erroneous. Hydrological observations proved decisively that Atlantic waters which flow into the Arctic Basin in deep currents spread up to the high latitudes north of Bering Strait.

A temporary meteorological station was set up on Zemlya Bunge in 1946.

Eighty-eight epicenters of earthquakes are located from 1910 to 1934 isolating a band of epicenters which passes through the mouth of the Lena River north to Severnaya Zemlya (North Land), Franz Josef Land and Spitzbergen and further through Jan Mayen and Iceland.

At 88 54 latitude and 339 longitude, the "North Pole" station found the depth to be 4,290 meters. Depths of over 4,000 meters continued to 85 33 latitude and 1 longitude. At 83 56, the depth had decreased to 2,380 meters, then began to increase and again reached 4,000 meters. Such great depth only 70 kilometers from the northeastern cape of Greenland, where a continental shelf was supposed to exist, was quite unexpected. Measurements were also made by the "Sadko" and the "Sedov" and listed. The greatest depth of the Arctic Basin is 5,180 meters, measured by the "Sedov" at 86 26 latitude and 135 34 longitude (north of Franz Josef Land).

In the Soviet Arctic, magnetic anomalies are most marked in Kola Bay, on Cape Pinogoriy, on Kol'din Island, on Teriberka (Murmansk), in the Red Army straits between North Land island, and in the northern part of the Taymyr Peninsula. Magnetic observations of the "Sedov," "Sadko," and "North Pole" made possible the construction of magnetic maps for the vast Arctic spaces between Greenland, the North Pole, and Vrangel' Island.

Under the ice of the Arctic Basin, to a depth of 150-200 meters, there is a very cold layer of sea water with temperatures close to freezing. Below this layer is a deep layer of comparatively warm and salty Atlantic water in which positive temperatures have been observed down to depths of 750-1,000 meters. Below this depth, the temperature gradually decreases, reaching -0.9°. These facts were derived from observations of the "Sedov," "Sadko," and "North Pole." A study of observations made in the Arctic Basin shows the following: the lowest temperature measured up to the present is -1.80° and the highest 2.68°, the lowest salinity is 2.952 percent, and the highest 3.497 percent.

Having generalized P. P. Shirshov's observations, A. D. Dobrovol'skiy stated that: (1) the speed of the deep Atlantic current decreases from the Greenland Sea to the pole; in the strait between Greenland and Spitzbergen, the speed of this current is about 0.5 mile per 24 hours, and about 0.1-0.2 mile per day at the pole; (2) the speed of the same flow from west to east is slightly greater; for example, it is about 1 mile per day in the Greenland-Spitzbergen strait (at 82 latitude) and about 0.3 to 0.5 mile per day at 85 longitude.

Bacteriological studies of organisms in the Arctic were made by both the "Sadko" and the "North Pole," the latter's revealing that forms characteristic of the Greenland Sea were found in plankton collected at the North Pole.

Preliminary study observations of the "North Pole" showed that the ice field drifted under both action of local winds and under actioh of the general southward movement independent of local wind. Drifts of both the "North Pole" and the "Sedov" confirmed Nansen's rules, i.e., (1) the drift speed of ice is approximately 1/50 the speed of wind causing this drift, and (2) the ice drifts at an angle of 30° to the direction of the wind causing this drift.

Further analysis of the drift of the "Sedov" and comparison with maps of the distribution of atmospheric pressure compiled in the Weather Bureau permitted Zubov to supplement Nansen's rules with the following: (1) the ice drift is directed along isobars and, moreover, is directed so that the region of high atmospheric pressure is located to the right and the region of low atmospheric pressure is to the left of the drift line; and (2) the ice drifts with a speed proportional to the gradient of atmospheric pressure, i.e., the drift speed is inversely proportional to the distance between isobars. This method should prove invaluable in both long-range and short-range forecasts of ice formations.

The warming of the Arctic involves the following: (1) the recession of glaciers and the thawing of islands, (2) the increase in air temperature, (3) the increase of the temperature of Atlantic water entering the Arctic Basin, (4) the decrease of iciness, (5) prolongation of the ship navigation season, and (6) biological indications of warming of the Arctic.

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